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**From:** James Rayner [James.Rayner@geosyntec.com]  
**Sent:** 8/9/2019 11:24:13 AM  
**To:** Ohl, Matthew [ohl.matthew@epa.gov]  
**CC:** nwbernstein@nwbllc.com; Peter Racher [pracher@psrb.com]; Gary Wealthall [GWealthall@Geosyntec.com]; Andrew A Gremos [agremos@ramboll.com]; Douglas Petroff [DPetroff@idem.IN.gov]; Krueger, Thomas [krueger.thomas@epa.gov]; Suzanne OHara [SOHara@Geosyntec.com]; Mark Nichter [Mark.W.Nichter@usace.army.mil]; Becker, David J CIV USARMY CEHNC (US) [Dave.J.Becker@usace.army.mil]  
**Subject:** RE: Slide Comments: Third Site groundwater flow modeling and capture zone analysis  
**Attachments:** Third Site Hydraulic Capture Modeling Report Final.pdf

Matt

Further to our previous email, we are pleased to submit the Third Site groundwater flow modeling and capture zone analysis written report for your consideration.

Regards,

James

**James Rayner, M.Sc.**  
Geosyntec Consultants, Inc.

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**From:** Gary Wealthall  
**Sent:** 01 August 2019 08:45  
**To:** Ohl, Matthew <ohl.matthew@epa.gov>  
**Cc:** nwbernstein@nwbllc.com; Peter Racher <pracher@psrb.com>; Andrew A Gremos <agremos@ramboll.com>; Douglas Petroff <DPetroff@idem.IN.gov>; Krueger, Thomas <krueger.thomas@epa.gov>; Suzanne OHara <SOHara@Geosyntec.com>; Mark Nichter <Mark.W.Nichter@usace.army.mil>; Becker, David J CIV USARMY CEHNC (US) <Dave.J.Becker@usace.army.mil>; James Rayner <James.Rayner@geosyntec.com>  
**Subject:** RE: Slide Comments: Third Site groundwater flow modeling and capture zone analysis

Matt

We are completing final review and revisions to the Third Site groundwater flow modeling and capture zone analysis written report. We anticipate a further 10 days to complete the report and respectfully request an extension until August 9, 2019 to submit the report to the EPA.

Best regards  
Gary

Gary Wealthall, PhD  
Senior Principal  
Geosyntec Consultants, Ltd

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**From:** Gary Wealthall  
**Sent:** 11 June 2019 13:24

**To:** Ohl, Matthew <ohl.matthew@epa.gov>

**Cc:** nwbernstein@nwblc.com; Peter Racher <pracher@psrb.com>; Andrew A Gremos <agremos@ramboll.com>; Douglas Petroff <DPetroff@idem.IN.gov>; Krueger, Thomas <krueger.thomas@epa.gov>; Suzanne OHara <SOHara@Geosyntec.com>; Mark Nichter <Mark.W.Nichter@usace.army.mil>; Becker, David J CIV USARMY CEHNC (US) <Dave.J.Becker@usace.army.mil>

**Subject:** RE: Slide Comments: Third Site groundwater flow modeling and capture zone analysis

Dear Matt

Thank you for your considered comments, received June 6, regarding the Third Site groundwater flow modeling and capture zone analysis.

We expect, given the fourth of July and Canada day holidays, to be able to provide a response to each of the comments by Friday, July 12. However, the request in the covering e-mail to incorporate the findings into "a written groundwater modeling report documenting the information necessary to support the findings presented in the slides and resolving the comments" is a much larger effort since no such report exists at this time. Accordingly, we respectfully request until at least July 31, 2019 to submit that report to EPA.

Best regards  
Gary Wealthall

Gary Wealthall, PhD  
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**From:** Ohl, Matthew <ohl.matthew@epa.gov>

**Sent:** 06 June 2019 14:24

**To:** Gary Wealthall <GWealthall@Geosyntec.com>

**Cc:** nwbernstein@nwblc.com; Peter Racher <pracher@psrb.com>; Andrew A Gremos <agremos@ramboll.com>; Douglas Petroff <DPetroff@idem.IN.gov>; Krueger, Thomas <krueger.thomas@epa.gov>; Suzanne OHara <SOHara@Geosyntec.com>; Mark Nichter <Mark.W.Nichter@usace.army.mil>; Becker, David J CIV USARMY CEHNC (US) <Dave.J.Becker@usace.army.mil>

**Subject:** Slide Comments: Third Site groundwater flow modeling and capture zone analysis

Good morning Gary:

Here are our comments on the slides. Please provide a written groundwater modeling report documenting the information necessary to support the findings presented in the slides and resolving the comments.

Thank you,

Matt

Matthew J. Ohl  
Remedial Project Manager  
United States Environmental Protection Agency  
77 West Jackson Boulevard, SR-6J

Chicago, IL 60604-3590

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- 1) General Comment: The model is probably hindered by limited information outside the immediate vicinity of the plume. Though the model is possibly useful to answer some questions, there will be uncertainties with these answers. There are some questions about the model that may affect the use for the purpose at hand and these are discussed in the subsequent comments.
- 2) General Comment: The hydraulic capture analysis is designed to address the center of the plume, but does little to address the full extent of the plume. Though likely beyond the extent of this study, further remedial action should be assessed and implemented to address groundwater contaminants that have extended beyond and hydraulically down-gradient of the EW-5 area.
- 3) Slide 13: There is an incomplete sentence in the caption to the figure which reads, "Elevation contours are in units of."
- 4) Slide 16: The basis for the extent of the paleochannel to the northwest and to the south is not clear and should be discussed.
- 5) Slide 21: Clarify the assumption that there is little interaction with surface water bodies and how it is supported. This could significantly affect the system flux and this would affect capture. Provide additional justification for this assumption.
- 6) Slide 21: Modeling Limitations and Assumptions. The first bullet notes *"the extent of the channel and its influence on groundwater flow is uncertain, in particular on its northern side."* Review available soil boring logs associated with the wells at the Envirochem Site. These data suggest the paleochannel in the Upper Sand and Gravel unit may extend in a northerly direction to a portion of Envirochem Site.
- 7) Slides 23, 26, and 29: Include legends and north arrows on these figures (where applicable).
- 8) Slide 26: The model boundaries include no-flow boundaries to the left and right, yet the model has the stream coming in from the right and presumably the stream would have some parallel underflow. Alternative conceptualizations of that boundary could be more realistic, and this could affect calibration and results. Explain why alternative conceptualizations were not adopted.
- 9) Slide 29: There would be other calibration targets, including inflow/outflow to the streams and observed hydraulic gradients. Please indicate if those were considered. Also, indicate basis for estimated pilot point heads.

- 10) Slide 30: The matches at the extraction wells are not expected to be good with the operational extraction system due to well efficiency effects and the fact that the model is computing mean head for the cell and not at the center of the cone of depression.
- 11) Slide 31: The residuals should be shown on a map to assess spatial bias in the calibration.
- 12) Slide 32: Are the calibrated K values consistent with the materials encountered in the wells that were calibration targets? Was the calibrated K value near EW-5 consistent with the pumping test? The values around EW-5 on this slide look low compared to the values from the pumping test. Please discuss.
- 13) Slide 32: The calibrated model mass balance, average residual, root-mean-square residual, etc. should be provided. Also, given the freedom allowed in the model to vary hydraulic conductivity over short distances in small cells, the horizontal anisotropy seems large. Please justify this. Also, please indicate if a sensitivity analysis was conducted for the model to assess the impact of the uncertainty in K values, boundary conditions, recharge, etc.
- 14) Slide 35: The compressed pathlines near the eastern edge of the capture zone suggest a high-K zone that is not indicated on the calibrated permeability map. Please explain that phenomenon.
- 15) Slide 38: Tripling the pumping rate should have a much more pronounced effect on the capture zone than shown. Please verify the figures shown here are correct.
- 16) Slide 39: Though it certainly better practice to prevent aeration of the screen during pumping (to avoid encrustation/biofouling problems), it is not clear that the deeper screen by itself would allow a substantially greater extraction rate. An increase in sustained well efficiency, not a deeper screen, allows the higher pumping rates that would increase capture. Note that extending the filter pack above the deeper screen and outside the casing to include more of the saturated interval may help improve overall capacity, especially in stratified materials.
- If both an inefficient well and an efficient well can sustain the same pumping rate in the same aquifer, the capture zones should be approximately equal. The figures on slide 40 should not differ from those on slide 38 for greater pumping from the existing EW-5 well.
- Note that avoiding fouling issues helps the efficiency, but near 100% efficiency is very difficult to achieve.
- 17) Slide 43: In addition to transport modeling, flow modeling and particle tracking should help answer the key questions for capture. Include assessing the fate of the contaminants that have migrated past the current or future capture zone(s) for EW-5 and other extraction wells.
- 18) Slide 43: Conclusions. Is there a recommendation for a preferred remedy to improve groundwater capture in the vicinity of EW-5 and MW-28?

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**From:** Gary Wealthall <[GWealthall@Geosyntec.com](mailto:GWealthall@Geosyntec.com)>

**Sent:** Tuesday, April 9, 2019 4:01 PM

**To:** Ohl, Matthew <ohl.matthew@epa.gov>

**Cc:** nwbernstein@nwblc.com; Peter Racher <pracher@psrb.com>; Andrew A Gremos <agremos@ramboll.com>; Douglas Petroff <DPetroff@idem.IN.gov>; Krueger, Thomas <krueger.thomas@epa.gov>; Suzanne OHara <SOHara@Geosyntec.com>

**Subject:** RE: Third Site groundwater flow modeling and capture zone analysis

Dear Matt

Please find attached the draft report for the Third Site groundwater flow modeling and capture zone analysis for the area of MW-28 and MW-29.

We are currently developing a draft Supplemental Sampling Work Plan, which will inform the supplemental sampling investigation to provide additional data to support a remedial alternatives analysis.

Once you have reviewed the attached report, we recommend a meeting, or conference call, to discuss the next steps.

Best regards

Gary

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Senior Principal  
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**From:** Gary Wealthall

**Sent:** 25 March 2019 22:00

**To:** 'Ohl, Matthew' <ohl.matthew@epa.gov>

**Cc:** 'Norman Bernstein' <nwbernstein@nwblc.com>; Peter M. Racher Esq. <pracher@psrb.com>; Andy Gremos <agremos@ramboll.com>

**Subject:** Third Site groundwater flow modeling for capture zone analysis

Dear Matt

The Third Site groundwater flow modeling for capture zone analysis in the area of MW-28 and MW-29 is close to completion. We respectfully request a two week extension for delivery of the modeling report, which would be now be submitted on Tuesday 9<sup>th</sup> April.

Best regards

Gary

Dr Gary Wealthall

Senior Principal & Branch Manager  
Adjunct Professor (Toronto)

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